

**A Flanged Joint**

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## Description

## Description of the Prior Art

- [0001] The present invention is based on a flanged joint comprising at least one flat gasket held between the facing flange surfaces of components, such as lines or container parts, which store or guide a pressurized medium, according to the preamble of claim 1.
- [0002] Such flanged joints are known from the prior art, wherein the flat gasket has the function of sealing the flanged joint as hermetically as possible with respect to the environment. Sealing the flanged joint with little or no leakage of environmentally hazardous media, such as oils, acids or toxic gases, is becoming ever more important in view of increased environmental consciousness and legal regulations, such as the TA 2003 air regulation or the VDI 2440 standard.
- [0003] Such flanged joints often have a drawback in that, due to the continuous contact with the aggressive and/or high-temperature media guided through the lines or stored in the containers, the flat gaskets decompose or dissolve and have to be replaced after a certain amount of time, which adds to personnel overhead.
- [0004] It is therefore an object of the present invention to further develop a flanged joint of the initially mentioned type in such a way that its flat gasket has an increased service life and is essentially maintenance free.
- [0005] According to the present invention, this object is achieved by the features of claim 1.
- [0006] Advantages of the invention
- [0007] The invention is based on the idea of arranging upstream of the flat gasket, in the direction of the pressure difference from the pressure side to the environment side, at least one lamella ring held in an annular groove and biased, essentially without a gap, against a working diameter radially opposing the annular groove. In the context of lamella rings, the working diameter means the diameter of the surface facing the annular groove which receives the lamella ring and along which the pressurized medium would flow due to the pressure difference from the pressure side to the environment side.

- [0008]** The biasing of the lamella ring serves to provide sealing, without a gap, with respect to the working diameter, while a small gap is left toward the bottom of the annular groove. The effect of such a lamella ring is therefore based on the same effect as with gap or labyrinth seals, i.e. it deflects the flow away from the working diameter toward the bottom of the groove and forms a throttle there due to the small leftover gap, at which pressure energy is lost. Due to flow redirection and throttling of the lamella ring a high pressure level is reduced to a low level and the flow is diminished along the working diameter.
- [0009]** The lamella ring acts as a protective seal for the flat gasket downstream and protects it against wear, in particular against high pressures, high temperatures and aggressive media, such as acids or toxic gases. Such lamella rings are made of a thin steel band or of a different material, are structurally simple and require only a small amount of structural space in both axial and radial directions. This is why they are simple to retrofit in existing flanged joints. They are also heat resistant and break resistant, which is why they are highly suitable for protecting the downstream flat gasket against aggressive and high-temperature media.
- [00010]** By providing the lamella rings according to the present invention, the service life of the flat gaskets can be considerably increased. In view of the fact that in industrial plants and in the manufacture of chemical equipment, there is often a great number of flanged joints, maintenance overhead and costs can be substantially reduced by the flanged joint of the present invention.
- [00011]** The features defined in the dependent claims allow the conception of advantageous embodiments and improvements of the invention as defined in claim 1.
- [00012]** Preferably, the lamella ring is held in the annular groove with a small axial play allowing for heat expansion.
- [00013]** According to a further embodiment, a plurality of lamella rings can be axially arranged in the annular groove in series, wherein it is advantageous, in view of the multiple labyrinthine redirection of the flow of the pressurized medium, if, of the plurality of lamella rings, at least the lamella ring facing the pressure side and the lamella ring facing the environment side are biased against the working diameter, and at least one lamella ring axially arranged between these lamella rings is biased against the bottom of the annular groove. As a consequence, in the manner of a labyrinth seal, the medium will be redirected several times between the individual lamella rings, which causes eddies and frictional losses and therefore uses up pressure energy, which advantageously increases the sealing

effect. Preferably, lamella rings of the same type are used for the lamella rings arranged in the annular groove.

[00014]           Herein one or more single-turn lamella rings with an axial abutment opening and made of a steel band extending in a single plane are used, for example. Such single-turn lamella rings can be made at particularly low cost and their biasing against the bottom of the groove or against the working diameter is easily adjustable in advance.

[00015]           Alternatively, single-turn disk-like lamella rings of a steel band formed in the manner and form of a disk spring, can be inserted in the annular groove. Due to the inclination of the lamella rings, the edges of the steel band can be biased against the groove surfaces of the annular groove in a sealing fashion, which also results in an improved sealing effect. It is particularly advantageous for at least one pair of two disk-like lamella rings opposing each other with respect to their disk-like form, to be used, because in this case there are two such sealing edges.

[00016]           According to another embodiment, double-turn lamella rings are used, wherein the ends of the double turns, in a relaxed state of the double-turn lamella ring, protrude to the inside or to the outside of the circular form provided by the remainder of the double-turn lamella ring, and are in alignment with the circular form in the stressed state of the double-turn lamella ring. The ends protruding inside or outside of the circular form ensure that the double turns are biased toward the inside and toward the outside in the inserted state. The circular form of the closed double turn over 360° ensures firm contact with the bottom of the groove or with the working diameter.

[00017]           If the two components joined by the flanged joint have a radially overlapping area, so that one of the components has an axially protruding annular collar engaging a complementary annular recess of the other component, which has its radially inner circumferential surface forming the working diameter, an annular groove radially open toward the outside can be formed in the axially protruding annular collar of the one component, which receives the lamella ring(s).

[00018]           Short description of the drawings

[00019]           Exemplary embodiments of the present invention are shown in the drawing and explained in more detail in the following description of the figures, in which:

[00020]           Fig. 1 is a cross-sectional view of an flanged joint according to the present invention in a preferred embodiment having three double-turn lamella rings axially arranged in series;

- [00021] Fig. 2 is a top view of one of the double-turn lamella rings of Fig. 1 in the relaxed state;
- [00022] Fig. 3 is a side view of the double-turn lamella ring of Fig. 2;
- [00023] Fig. 4 is a top view of the double-turn lamella ring of Fig. 2 in the biased state;
- [00024] Fig. 5 is an enlarged detail of Fig. 1;
- [00025] Fig. 6 is an enlarged detail of a further embodiment;
- [00026] Fig. 7 is an enlarged detail of a further embodiment; and
- [00027] Fig. 8 is an enlarged detail of a further embodiment.
- [00028] Detailed description of the exemplary embodiments
- [00029] Fig. 1 shows a preferred embodiment of a flanged joint 1 according to the present invention. Flanged joint 1 comprises a flat gasket 10 held between the facing planar flange surfaces 2, 4 of two components 6, 8 which store or guide a pressurized medium. The components are, for example, cylindrical gas tubes 6, 8 or lines, wherein the gas has a higher pressure than the environmental pressure. However, any other flanged joint is also conceivable, such as for mounting container components. The flanged joint can be fixed or moveable, such as with rotating tubes. Flat gasket 10, as a hermetic seal, is for preventing any gas from leaking from the interior 12 of the tubes.
- [00030] According to the invention, upstream in the direction from the higher pressure of a pressure side on the inside 12 of tubes 6, 8 toward the lower pressure on an environment side 14 of flat gasket 10, at least one lamella ring 18 is held in an annular groove 16 and biased in an essentially gapless manner with respect to a facing working diameter 40. Preferably this is facilitated by having one or more lamella rings 18 in annular groove 16 arranged parallel to the plane of flange surfaces 2, 4 with little axial play. Preferably, according to the embodiment of Fig. 1, three double-turn lamella rings 20, 22, 24, are axially arranged in the annular groove in series (Fig. 5).
- [00031] Double-turn lamella rings 20, 22, 24 preferably consist each of two superimposed layers of a steel band of constant width or of a band of a different metal. The steel material is preferably C75, CK60 grade spring steel or a No. 1.4310, No. 1.4571 or No. 1.4980 chromium nickel steel.
- [00032] Fig. 2 shows double-turn lamella ring 20 facing the pressure side, biased against working diameter 40 and therefore toward the outside, which is identical to double-turn lamella ring 24 facing the environment side. With such double-turn lamella rings 20, 24 biased radially toward the outside, free ends 26, 28 of the double turns, departing from a circular form of the rest of double-turn lamella ring 20, protrude toward the inside in a

relaxed state of double-turn lamella ring 20, 24 shown in Fig. 2. Ends 26, 28 protruding toward the inside will ensure that the double turns of double-turn lamella rings 20, 24 in the inserted state are biased radially toward the outside, against working diameter 40, essentially without a gap. In the biased or inserted state of double-turn lamella rings 20, 24, ends 26, 28 will then be aligned with the circular form, as shown in Fig. 4.

**[00033]** With double-turn lamella ring 22 biased toward the bottom of annular groove 16, the free ends of the double turns protrude toward the outside departing from the circular form of the rest of double-turn lamella ring 22 in the relaxed state of double-turn lamella ring 22. Ends 26, 28 protruding toward the outside ensure that the double turns of double-turn lamella ring 22 are biased radially toward the inside, here against the bottom of annular groove 16, in the inserted state, essentially without a gap.

**[00034]** In order to achieve continuous, flat end faces without steps, each of the steel bands of double-turn lamella rings 20, 22, 24 has an offset 30 in the area of free ends 26, 28 (Fig. 3).

**[00035]** As shown in Fig. 1, the two tubes 6, 8 have a radially overlapping area 32 in such a way that one 6 of the tubes has an axially protruding annular collar 34 engaging a complementary, annular recess 36 of the other tube 8. To accommodate the three double-turn lamella rings 20, 22, 24, annular groove 16 is formed in axially protruding annular collar 34 of one 6 of the tubes and radially open toward the outside. A radially outward circumferential surface 38 of annular collar 34 and a radially inner circumferential surface 40 of recess 36 are on virtual cylindrical surfaces which are coaxial with a tube axis 42. The end faces of annular collar 34 of the one 6 of the tubes is spaced from an annular bottom surface of recess 36 of the other tube 8 by a small gap 44 allowing for thermal expansion of tubes 6, 8 in an axial direction.

**[00036]** In the context of lamella rings, the working diameter is the diameter of the surface facing annular groove 16 which receives the lamella ring(s) and along which the pressurized medium would flow due to the pressure difference from the pressure side to the environment side. In the present case, the radially inner circumferential surface 40 of recess 36 of the other tube 8 thus forms the working diameter against which double-turn lamella rings 20, 24 are radially biased.

**[00037]** The other circumferential surfaces of double-turn lamella rings 20, 22, 24 each have a small gap 46 toward the bottom of annular groove 16 or toward working diameter 40. In this way a labyrinth seal is formed. The gas guided under pressure in interior 12 of tubes 6, 8 is applied to radial gap 44 and in particular to double-turn lamella ring 20 facing

the pressure side and biased against the working diameter. Due to the alternating arrangement of double-turn lamella rings 20, 22, 24, as lamella rings biased toward the outside against working diameter 40 or toward the inside against the bottom of annular groove 16 and the resulting sequence of the gap thus left free (inside, outside, inside) flow redirections are mainly in a radial direction, which achieves substantial throttling or pressure loss, so that only a very small amount and sometimes no gas at all passes along working diameter 40 and to flat gasket 10.

**[00038]** To achieve such a labyrinthine redirection with the plurality of lamella rings axially arranged in sequence, it is therefore generally advantageous that, of the plurality of lamella rings axially arranged in series, at least lamella ring 20 facing the pressure side and lamella ring 24 facing the environment side is biased against working diameter 40 and at least one lamella ring 22 arranged axially between these lamella rings 20, 24 is biased against the bottom of annular groove 16.

**[00039]** Fig. 6 shows another embodiment in which instead of three double-turn lamella rings only one double-turn lamella ring 48 biased against working diameter 40 is held in annular groove 16 with its width adapted to ensure a small axial play.

**[00040]** Fig. 7 illustrates an embodiment in which instead of three double-turn lamella rings, three single-turn lamella rings 50, 52, 54 of a band of steel, or other metal, of constant width extending in one plane are held in annular groove 16. As will be readily understood, such a single-turn lamella ring 50, 52, 54 has an abutment opening between its free ends allowing the bias against working diameter 40 to be adjusted. The three single-turn lamella rings 50, 52, 54 are therefore all outside biased lamella rings biased against radially inner circumferential surface 40 of recess 36 of the other tube 8.

**[00041]** Finally, Fig. 8 shows an embodiment in which two single-turn conical lamella rings 56, 58 are used biased radially toward the outside of a steel band conically formed in the manner of a disk spring, wherein they are arranged in annular groove 16 in an axially opposing relationship with respect to their conical form. Due to the inclination of conical lamella rings 56, 58, the edges of the steel band, as sealing edges 60, sealingly engage the surfaces of annular groove 16.

**[00042]** The invention is not limited to the embodiments described. Further types of lamella rings and combinations of different lamella rings are also conceivable in a single annular groove.

**[00043]** According to another embodiment, not shown in the figures, the two tubes 6, 8 can have an axial recess like recess 36, which is engaged by a separate ring, symmetrical with

respect to its center plane, and which is provided with two annular grooves axially arranged adjacent to each other and on the same diameter. The one annular groove will be associated with the working diameter of one 6 of the tubes and the other annular groove will be associated with the other tube 8. In this case the ends of the tubes could advantageously be manufactured as standardized components.